

REMARKS

It is hereby requested that the time for responding to the Office Action mailed February 4, 2002 be extended one month to June 4, 2002. The extension fee of \$130 is enclosed herewith. The Commissioner is authorized to charge any deficit or credit any overpayment to Deposit Account 22-0261.

In accordance with the Examiner's requirement, the word "handle" on page 1, line 18 has been changed to "handling."

The Examiner has indicated that the phrase "keeping parallel two lines of a line" in lines 14 and 15 of page 2 and in line 4 of page 7 is unclear. The phrases objected to by the Examiner have been amended to clarify the meaning of the description. In addition, other places in the specification containing similar language have also been amended.

The Examiner has also made a similar objection to claim 1, objecting to the phrase "keeping parallel two lines of a line passing through the first and second end portions of the first arm length and the symmetrical line with respect to the center line with the line passing through the first and second end portions of the second arm link." In claim 1 as amended, the phrase objected to by the Examiner has been amended to read "keeping parallel two lines including a line passing through the first and second portions of the first arm link and a line symmetrical with respect to the center line with the line passing through the first and second portions of the second arm link." Corresponding expressions found in claims 8, 22, 25 and 28 have been similarly amended. The meaning intended to be conveyed by the expression in question can be explained by reference to the enclosed sketch submitted herewith. The expression is intended to cover generically an arrangement shown in sketch A and sketch B wherein the link 811 is parallel or coaxial with the line L2 which is symmetrical with a line passing through the first and

second portions of the arm link 812. The claim is considered generic to the arrangement of sketch A and sketch B because of the fact that the state of being coaxial is considered to be a special case of the state of being parallel. In view of the amendments to the specification and to the claims, it is submitted that the Examiner's objection to the phrases in question is no longer applicable.

In claim 1 the Examiner has also alleged that the parallel relationship recited in line 2 and line 8 on page 50 is inaccurate and contends that the phrase "axial alignment" should be used. In view of the Examiner's objection, the claim has been amended to use the phrase "axial alignment" instead of "parallel relationship" as the Examiner has suggested. However, as pointed out above, it is submitted that axial alignment is a special case of a parallel relationship.

The Examiner has further rejected claims 1, 16, 18, 30, 31, and 32 under 35 U.S.C. 112 as containing subject matter which is not described in the specification in a way to reasonably convey to one skilled in the relevant art that the inventor at the time the invention was filed had possession of the claimed invention. In the first place it is submitted the Examiner has misstated the requirement of the first paragraph of 35 U.S.C. 112. This paragraph requires that the specification contain a written description of the invention to enable anyone skilled in the art to make and use the invention. The requirement is not a requirement on the claims and the first paragraph of 35 U.S.C. 112 contains no requirement with respect to showing that the inventor had possession of the claimed invention at the time the invention was filed. To support the Examiner's rejection, the Examiner states that the problem is that the specification calls for 691 to be integrally formed and in coaxial relationship with 975 and also calls for the first end of 975 and the second end of 691 to be connected to 971 and the first end of 691 to be connected to the second end portion of 694 whereas, in the Examiner's view, the drawings show that 975 and 691

A

are overlapping but not in coaxial alignment and that 691 is connected to 121 and not 694. The basis for the Examiner's allegation that the links 975 and 691 are not shown to be in coaxial alignment is not understood. The specification uses the phrase "coaxial relationship," which means that the parts being described have a common axis. The link 691 and the link 975 overlap and do have a common axis and therefore have a coaxial relationship as described in the specification. The showing in Figure 31 is consistent with 691 and 975 being coaxial. If the basis of the Examiner's contention is that a coaxial relationship requires that the parts being described are coextensive along the axis, it is submitted that this interpretation of the phrase coaxial relationship is incorrect. Coaxial as used in the specification merely means that the two parts being described as being coaxial have a common axis.

The Examiner also alleges that the drawings show the link 691 connected to the first driving shaft 121 but not to link 694. However, as shown in Figure 31 and as described on page 45 and 46, the first driving shaft 121 is rotatably received in the hollow shaft 122 and the second driving shaft 122 is integrally connected to the link 694. The shaft 121 is integrally connected to the shaft 975, which is integrally formed with the link 691. As a result of this arrangement the link 694 is pivotally connected to the link 691 about the axis 123 of the shafts 121 and 122 as described on page 46, lines 6-8. Accordingly, it is submitted that the specific allegation of the Examiner regarding an alleged inconsistency between the specification and the drawings is incorrect and not well taken. With regard to the Examiner's general objection that it is unclear how the arm links 973, 971, shafts 121 and 122 and the driving assist parallelogram 690 are all interrelated, it is submitted that this interrelationship is all fully and completely described in the specification on pages 44 through 46. As described therein, the arm link 971 and the arm link 975 are pivotally connected with each other and the arm link 973 is pivotally connected to the

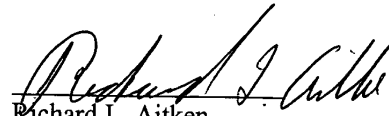
arm link 975 as described in the paragraph bridging pages 44 and 45. The driving shaft 121 is rotatably received in the hollow drive shaft 123 and both shafts rotate about the rotation axis 123 as described in the paragraph on page 45, lines 18- 28. The assist parallelogram linkage 690 includes a first link 691 integrally formed with and in coaxial relationship with the arm link 975 as described on page 45, lines 25-28. The parallelogram linkage 690 further includes a second link 692 which is pivotally connected to the link 691 as described on page 45, lines 29-32. The parallelogram linkage 690 further includes the link 693 which is pivotally connected to the link 692 as described in the paragraph from line 36, page 45 to line 3 of page 46. The parallelogram linkage 690 further includes a link 694 which is pivotally connected to the link 693, as described in the paragraph on page 46, lines 4-12, and is also pivotally connected to the link 691 so that the link 691 is parallel to the link 693 and the link 692 is parallel to the link 694. As explained above, the pivotal connection between the links 691 and 694 is through the shaft 121, which is integrally connected to the shaft 691 and which is rotationally mounted within the hollow shaft 122, which is integrally connected to the link 694 as described on page 46, lines 17-20. Accordingly, it is submitted that the disclosure on pages 44-46 makes it entirely clear how the arm links 973, 971, the shafts 121 and 122, and the assist parallelogram linkage 690 are interrelated. Since the interrelationship is described, it is submitted that Examiner's rejection of claims 1, 16, 18, 30, 31 and 32 as containing subject matter which is not described in the specification is not well taken and should be withdrawn.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attachment is captioned "Version with markings to show changes made."

In view of the foregoing it is submitted that this application is in condition for allowance and favorable reconsideration thereof is respectfully requested.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Paragraph beginning at page 1, line 16 has been amended as follows:

A conventional robot arm mechanism of this kind is disclosed in, for example, Japanese patent laying-open publication Tokkaihei 7-227777 and comprises a ~~handle~~ handling member for holding and releasing objects, and robot arms for operating and moving the hand. The robot arms are constituted by a plurality of parallel links having joint portions on which are provided synchronous gears for maintaining the links in their parallel attitudes. The synchronous gears are rotated to have the hand maintained in its predetermined direction by moving the hand forwardly and rearwardly while the parallel links are operated. Another conventional robot arm mechanism of this kind is disclosed in Japanese patent laying-open publication Tokkaihei 9-272084 and comprises robot arms constituted by a plurality of parallel links to form a parallelogram linkage contractable and extensible, and a synchronous motion mechanism including gears, belts and pulleys operatively mounted on the links. The synchronous motion mechanism is operated to have gears, belts and pulleys driven so that the parallelogram linkage can be contracted and extended.

Paragraph beginning at page 2, line 7 has been amended as follows:

According to the first aspect of the present invention there is provided a robot arm mechanism comprising: a handling member for supporting and handling an object; a robot arm connected to the handling member, the robot arm comprising a first arm link having first and second end portion, a second arm link having first and second end portion, and a link retaining mechanism having a center line, the link retaining mechanism pivotably retaining the first and second arm links respectively at the first end portions of the first and second arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second ~~end~~ portions of the first arm link and ~~the~~ a line symmetrical ~~line~~ with respect to the center line with the line passing through the first and second ~~end~~ portions of the second arm link, the link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than

the first short link of the first joint cross linkage of the link retaining mechanism, the first short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism and the second short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the link retaining mechanism, the second short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the link retaining mechanism, the second long link of the first joint cross linkage of the link retaining mechanism and the first short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the link retaining mechanism under the state that the second long link of the first joint cross linkage of the link retaining mechanism is crossed with the first long link of the first joint cross linkage of the link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the link retaining mechanism, the first short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the link

retaining mechanism, the first long link of the second joint cross linkage of the link retaining mechanism and the second short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the link retaining mechanism, the second short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the link retaining mechanism, the second long link of the second joint cross linkage of the link retaining mechanism and the first short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism under the state that the second long link of the second joint cross linkage of the link retaining mechanism is crossed with the first long link of the second joint cross linkage of the link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the link retaining mechanism to each of the first and second long links of the first joint cross linkage of the link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the link retaining mechanism to each of the first and second long links of the second joint cross linkage of the link retaining mechanism, the first short link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is

connected with the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of any one of the first and second arm links integrally formed with the second short link of the first joint cross linkage of the link retaining mechanism, the first end portion of the other one of the first and second arm links integrally formed with the second long link of the second joint cross linkage of the link retaining mechanism; and a robot arm driving mechanism for driving the robot arm.

Paragraph beginning at page 7, line 2 has been amended as follows:

The link retaining mechanism 200 pivotably retains the first and second arm links 811 and 812 respectively at the first end portions of the first and second arm links 811 and 812 and keeps parallel two lines ~~of the~~ including a line passing through the first and second ~~end~~-portions of the first arm link 811 and ~~the~~ a line symmetrical ~~line~~-with respect to the center line 201 with the line passing through the first and second ~~end~~-portions of the second arm link 812. In fact the first and second arm links 811 and 812 are in symmetrical relationship with each other with respect to the center line 201.

Paragraph beginning at page 12, line 26 has been amended as follows:

The link retaining mechanism 200 pivotably retains the first and second arm links 821 and 822 respectively at the first end portions of the first and second arm links 821 and 822 and keeps parallel two lines ~~of the~~ including a line passing through the first and second ~~end~~-portions of the first arm link 821 and ~~the~~ a line symmetrical ~~line~~-with respect to the center line 201 with the line passing through the first and second ~~end~~-portions of the second arm link 822. The first end portion of the first arm link 821 is integrally formed with the second short link 213. The first end portion of the second arm link 822 is integrally formed with the second long link 224. The first end portions of the first and second arm links 821 and 822 are positioned on the center line 201. In fact the first and second arm links 821 and 822 are in symmetrical relationship with each other with respect to the center line 201.

Paragraph beginning at page 15, line 25 has been amended as follows:

The link retaining mechanism 300 pivotably retains the first and second arm links 831 and 832 respectively at the first end portions of the first and second arm links 831 and 832 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the first arm link 831 and ~~the~~ a line symmetrical ~~line~~ with respect to the center line 301 with the line passing through the first and second end portions of the second arm link 832.

Paragraph beginning at page 20, line 7 has been amended as follows:

The link retaining mechanism 350 pivotably retains the first and second arm links 851 and 852 respectively at the first end portions of the first and second arm links 851 and 852 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the first arm link 851 and ~~the~~ a line symmetrical ~~line~~ with respect to the center line 351 with the line passing through the first and second end portions of the second arm link 852.

Paragraph beginning at page 23, line 17 has been amended as follows:

The robot arm 880 further comprises a fifth arm link 885 having first and second end portion, a sixth arm link 886 having first and second end portion, and an additional link retaining mechanism 250 having an additional center line 251. The additional link retaining mechanism 250 pivotably retains the fifth and sixth arm links 885 and 886 respectively at the first end portions of the fifth and sixth arm links 885 and 886 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link 885 and ~~the~~ a line symmetrical ~~line~~ with respect to the additional center line 251 with the line passing through the first and second end portions of the sixth arm link 886. In fact the fifth and sixth arm links 885 and 886 are in symmetrical relationship with each other with respect to the center line 251.

Paragraph beginning at page 26, line 11 has been amended as follows:

The link retaining mechanism 400 pivotably retains the first and second arm links 891 and 892 respectively at the first end portions of the first and second arm links 891 and 892 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions

of the first arm link 891 and ~~the~~ a line symmetrical ~~line~~ with respect to the center line 401 with the line passing through the first and second end portions of the second arm link 892. In fact the first and second arm links 891 and 892 are in symmetrical relationship with each other with respect to the center line 401.

Paragraph beginning at page 29, line 28 has been amended as follows:

The link retaining mechanism 500 pivotably retains the first and second arm links 901 and 902 respectively at the first end portions of the first and second arm links 901 and 902 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the first arm link 901 and ~~the~~ a line symmetrical ~~line~~ with respect to the center line 501 with the line passing through the first and second end portions of the second arm link 902. In fact the first and second arm links 901 and 902 are in symmetrical relationship with each other with respect to the center line 501.

Paragraph beginning at page 35, line 37 has been amended as follows:

The robot arm 930 further comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retainins the fifth and sixth arm links 935 and 936 respectively at the first end portions of the fifth and sixth arm links 935 and 936 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link 935 and ~~the~~ a line symmetrical ~~line~~ with respect to the additional center line 451 with the line passing through the first and second end portions of the sixth arm link 936. In fact the fifth and sixth arm links 935 and 936 are in symmetrical relationship with each other with respect to the additional center line 451.

Paragraph beginning at page 38, line 28 has been amended as follows:

The robot arm 940 further comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retains the

fifth and sixth arm links 945 and 946 respectively at the first end portions of the fifth and sixth arm links 945 and 946 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link 945 and ~~the~~ a line symmetrical ~~line~~-with respect to the additional center line 451 with the line passing through the first and second end portions of the sixth arm link 946. In fact the fifth and sixth arm links 945 and 946 are in symmetrical relationship with each other with respect to the additional center line 451.

Paragraph beginning at page 40, line 18 has been amended as follows:

The robot arm 950 further comprises a fifth arm link 955 having first and second end portion and a sixth arm link 956 having first and second end portion. The robot arm 950 further comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retains the third and fourth arm links 953 and 954 respectively at the first end portions of the third and fourth arm links 953 and 954 and keeps parallel two lines ~~of the~~ including a line passing through the first and second end portions of the third arm link 953 and ~~the~~ a line symmetrical ~~line~~-with respect to the additional center line 451 with the line passing through the first and second end portions of the fourth arm link 954. In fact the third and fourth arm links 953 and 954 are in symmetrical relationship with each other with respect to the additional link retaining mechanism 450.

In the Claims

Claim 1 has been amended as follows:

1. (Amended) A robot arm mechanism comprising:
 - a handling member for supporting and handling an object;
 - a robot arm connected to the handling member, the robot arm comprising a first arm link having first and second end portion, a second arm link having first and second end portion, and a link retaining mechanism having a center line, the link retaining mechanism pivotably retaining the first and second arm links respectively at the first end portions of the first and second arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second end portions of the first arm link and ~~the~~ a line symmetrical ~~line~~-with respect to the

center line with the line passing through the first and second end portions of the second arm link, the link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the link retaining mechanism, the first short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism and the second short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the link retaining mechanism, the second short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the link retaining mechanism, the second long link of the first joint cross linkage of the link retaining mechanism and the first short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the link retaining mechanism under the state that the second long link of the first joint cross linkage of the link retaining mechanism is crossed with the first long link of the first joint cross linkage of the link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the link retaining mechanism, the first short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the link

retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the link retaining mechanism, the first long link of the second joint cross linkage of the link retaining mechanism and the second short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the link retaining mechanism, the second short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the link retaining mechanism, the second long link of the second joint cross linkage of the link retaining mechanism and the first short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism under the state that the second long link of the second joint cross linkage of the link retaining mechanism is crossed with the first long link of the second joint cross linkage of the link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the link retaining mechanism to each of the first and second long links of the first joint cross linkage of the link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the link retaining mechanism to each of the first and second long links of the second joint cross linkage of the link retaining mechanism, the first short link of the first joint cross linkage of the link retaining mechanism integrally formed with and in ~~parallel relationship~~ axial alignment with the first long link of the second joint cross linkage of the link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the

link retaining mechanism integrally formed with and in ~~parallel relationship~~ axial alignment with the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of any one of the first and second arm links integrally formed with the second short link of the first joint cross linkage of the link retaining mechanism, the first end portion of the other one of the first and second arm links integrally formed with the second long link of the second joint cross linkage of the link retaining mechanism; and

a robot arm driving mechanism for driving the robot arm.

Claim 8 has been amended as follows:

8. (Amended) A robot arm mechanism as set forth in claim 7 in which the robot arm further comprises:

a fifth arm link having first and second end portion;

a sixth arm link having first and second end portion;

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link and ~~the~~ a line symmetrical ~~line~~ with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of

the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional

link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint

cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the additional center line, the second end portion of the first arm link and the first end portion of the third arm link connected with each other, the second end portion of the second arm link and the first end portion of the fourth arm link connected with each other, the first long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism substantially equal in length to each other, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism;

a first stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the first arm link, the first link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the first arm link under the state that the first end portion of the first link of the first stabilizing parallelogram linkage is connected with the first end portion of the first arm link, a second link having first and second end portions and substantially equal in length to the fifth arm link, the first and second links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the first stabilizing parallelogram linkage and the first end portion of the second link of the first stabilizing parallelogram linkage, the second link of the first stabilizing parallelogram linkage integrally formed with and in parallel relationship with the third arm link under the state that the first end portion of the second link of

the first stabilizing parallelogram linkage is connected with the first end portion of the third arm link, a third link having first and second end portions and substantially equal in length to the first link of the first stabilizing parallelogram linkage, the second and third links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the first stabilizing parallelogram linkage and the first end portion of the third link of the first stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the first stabilizing parallelogram linkage, the third and fourth links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the first stabilizing parallelogram linkage and the first end portion of the fourth link of the first stabilizing parallelogram linkage, the fourth and first links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the fourth link of the first stabilizing parallelogram linkage and the first end portion of the first link of the first stabilizing parallelogram linkage under the state that the first link of the first stabilizing parallelogram linkage is in parallel relationship with the third link of the first stabilizing parallelogram linkage and that the second link of the first stabilizing parallelogram linkage is in parallel relationship with the fourth link of the first stabilizing parallelogram linkage, the fourth link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the fifth arm link under the state that the second end portion of the fourth link of the first stabilizing parallelogram linkage is connected with the first end portion of the fifth arm link; and

a second stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the second arm link, the first link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the second arm link under the state that the first end portion of the first link of the second stabilizing parallelogram linkage is connected with the first end portion of the second arm link, a second link having first and second end portions and substantially equal in length to the sixth arm link, the first and second links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the second stabilizing parallelogram linkage and the first end portion of the second link of the second stabilizing parallelogram linkage, the second link of the second stabilizing parallelogram linkage integrally formed with and in parallel relationship with the fourth arm link under the state that the first end

portion of the second link of the second stabilizing parallelogram linkage is connected with the first end portion of the fourth arm link, a third link having first and second end portions and substantially equal in length to the first link of the second stabilizing parallelogram linkage, the second and third links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the second stabilizing parallelogram linkage and the first end portion of the third link of the second stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the second stabilizing parallelogram linkage, the third and fourth links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the second stabilizing parallelogram linkage and the first end portion of the fourth link of the second stabilizing parallelogram linkage, the fourth and first links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the fourth link of the second stabilizing parallelogram linkage and the first end portion of the first link of the second stabilizing parallelogram linkage under the state that the first link of the second stabilizing parallelogram linkage is in parallel relationship with the third link of the second stabilizing parallelogram linkage and that the second link of the second stabilizing parallelogram linkage is in parallel relationship with the fourth link of the second stabilizing parallelogram linkage, the fourth link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the sixth arm link under the state that the second end portion of the fourth link of the second stabilizing parallelogram linkage is connected with the first end portion of the sixth arm link.

Claim 22 has been amended as follows:

22. (Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:

a fifth arm link having first and second end portion;

a sixth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first

end portions of the fifth and sixth arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link and ~~the~~ a line symmetrical ~~line~~ with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross

linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism; the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the

additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second

joint cross linkage of the additional link retaining mechanism, the first joint mechanism retaining the fifth arm link at the second end portion of the fifth arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the third arm link, the second joint mechanism retaining the sixth arm link at the second end portion of the sixth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the fourth arm link.

Claim 25 has been amended as follows:

25. (Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:

- a fifth arm link having first and second end portion;
- a sixth arm link having first and second end portion;
- a seventh arm link having first and second end portion;
- a eighth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other, the seventh and eighth arm links substantially equal in length to each other;

- a third joint mechanism retaining the fifth and seventh arm links respectively at the second end portion of the fifth arm link and the first end portion of the seventh arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the seventh arm link;

- a fourth joint mechanism retaining the sixth and eighth arm links respectively at the second end portion of the sixth arm link and the first end portion of the eighth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the eighth arm link; and

- an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second end portions of the fifth arm link and ~~the~~ a line symmetrical line with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first

joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the

second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link

retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, any one of the first and second driving shafts rotating the eighth arm link around the second end portion of the eighth arm link, the other one of the first and second driving shafts rotating the seventh arm link around the

second end portion of the seventh arm link, the second end portions of the eighth and seventh arm links positioned on the rotation axis.

Claim 28 has been amended as follows:

28. (Amended) A robot arm mechanism as set forth in claim 16 which further comprising an additional handling member, the robot arm further comprising:


- a third arm link having first and second end portion;
- a fourth arm link having first and second end portion, the first, second, third, and fourth arm links substantially equal in length to each other;
- a fifth arm link having first and second end portion;
- a sixth arm link having first and second end portion; and
- an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the third and fourth arm links respectively at the first end portions of the third and fourth arm links and keeping parallel two lines ~~of the~~ including a line passing through the first and second end portions of the third arm link and ~~the~~ a line symmetrical ~~line~~ with respect to the additional center line with the line passing through the first and second end portions of the fourth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first

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joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably

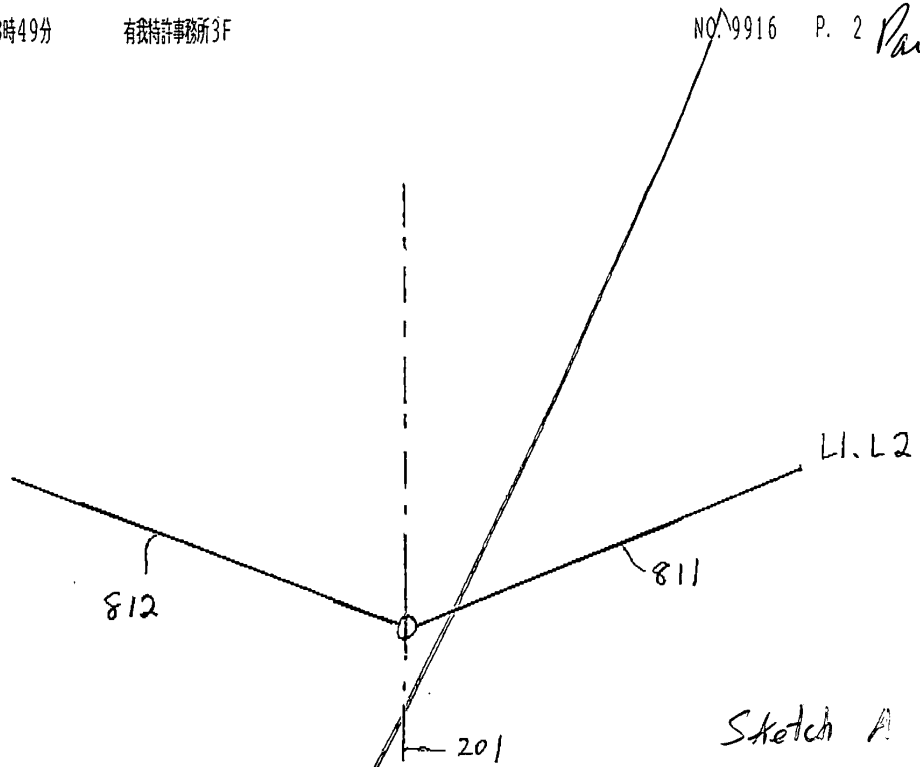
connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the third and fourth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the third and fourth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the distance between the second end portion

of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the handling member having a first and second portions, the additional handling member having a first and second portions, the first arm link and the handling member pivotably connected with each other at the second end portion of the first arm link and the first portion of the handling member, the third arm link and the handling member pivotably connected with each other at the second end portion of the third arm link and the second portion of the handling member, the fourth arm link and the additional handling member pivotably connected with each other at the second end portion of the fourth arm link and the first portion of the additional handling member, the second arm link and the additional handling member pivotably connected with each other at the second end portion of the second arm link and the second portion of the additional handling member, the arm driving mechanism comprising a first driving shaft rotatable around a rotation axis, and a second driving shaft in the form of a hollow shape to rotatably receive therein the first driving shaft and rotatable around the rotation axis, any one of the first and second driving shafts rotating the fifth arm link around the second end portion of the fifth arm link, the other one of the first and second driving shafts rotating the sixth arm link around the second end portion of the sixth arm link, the second end portions of the fifth and sixth arm links positioned on the rotation axis, the fifth arm link pivotable around the second end portion of the fifth arm link, the sixth arm link pivotable around the second end portion of the sixth arm link, the first end portion of the fifth arm link pivotally connected with the first long link of the first joint cross linkage of the link retaining mechanism or the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the fifth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of the sixth arm link pivotally connected with the first long link of the first joint cross linkage of the additional link retaining mechanism or the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end

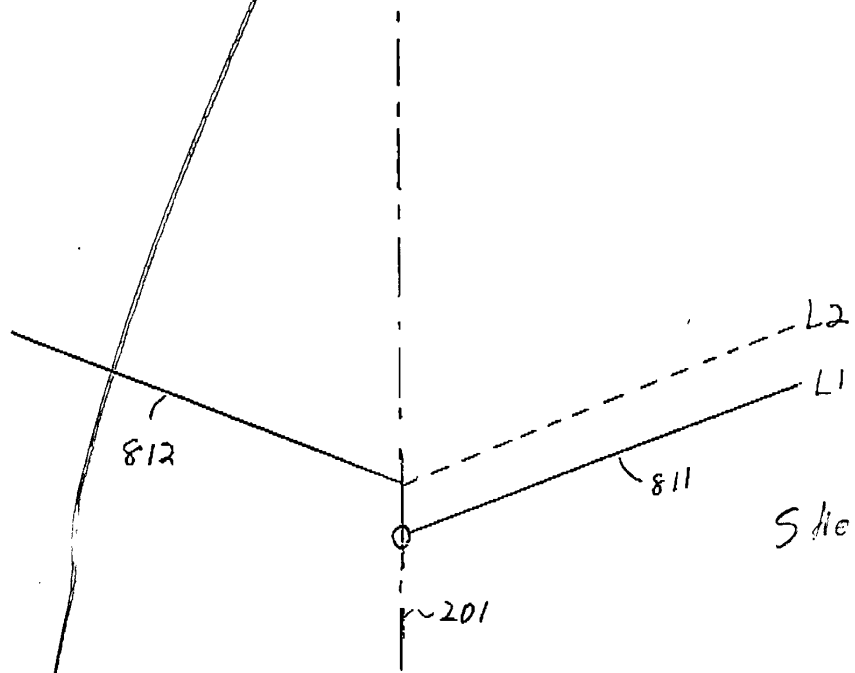


portion of the sixth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism.

not Approved
invent 812/02



Sketch A



Sketch B

200 (Second Type)